UTAH DEPARTMENT OF TRANSPORTATION

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Structural Steel Coatings: Surface Preparation

Protective coatings can provide significant long-term savings and return on a structural steel investment. The proper applications of a structural steel coating, reduce or eliminate the risk of early failure, the need for structural repair and replacement, and other factors leading to increased life-cycle costs. Coating operations typically account for only a small portion of most capital projects and maintenance budgets, around 4%.

Protective coatings are used to isolate the steel from the elements thereby stopping moisture, a primary factor in rust development. If the coating completely covers the surface and is thick enough to insulate the steel, corrosion is stopped.

There are three mechanisms by which coatings can provide corrosion protection. First, coatings act as a barrier by isolating the steel from moisture and oxygen. Second, inhibitive primer coatings contain passivating pigments. These are low solubility pigments that migrate to the steel surface when moisture passes through the film and passivate the steel surface. Third, there are sacrificial primers that contain pigments such as elemental zinc. Since zinc is higher than iron in the EMF (electromotive force) series, when corrosion conditions exist, the zinc is the anode and corrodes to protect the steel. Sacrificial primers require intimate contact between the steel surface and the zinc particles in the primer.

Corrosion protection by coatings is a function of the total system. The term "Coating System" refers to the level of cleanliness the substrate gets prior to coating and application of a number of coats, separately applied, in a predetermined order and thickness. UDOT cleanliness is SSPC (Structural Steel Painting Council) specified, which calls out a two or three-part system, that has been tested in the field by NEPCOAT (http://www.nepcoat.org/qualprodlist.pdf).

PROPER APPLICATION

The first step in any coating operation is surface preparation. The higher the cleanliness of the surface, the longer the coating system will protect. Some types of coatings require a blast-cleaned surface to perform properly. The purpose of the surface preparation is to clean and modify the existing surface sufficiently to achieve adhesion of the new coating. The surface must be cleaned to remove contaminants and roughened to promote adhesion. Adhesion is the primary key in achieving an effective coating. Adhesion includes both chemical and mechanical bonds. Surface preparation cleans the steel and exposes reactive sites for chemical bonding. Roughening the surface increases surface area, which both exposes more sites for chemical bonds and promotes mechanical bonding of the coating. Surface preparation is accomplished in multiple steps.

The first step in field cleaning is removal of gross contaminants, such as dirt, bird nests, and other debris that is most easily removed by hand, broom, or compressed air. Mill scale deposits are mot effectively removed by impact. If abrasive blasting is specified, removing these deposits prior to blasting is required, as abrasive blasting polishes heavy scale and is not an effective method to remove rust scale, or pack rust.

The mechanical methods of surface preparation are solvent cleaning, hand tool cleaning and power tool cleaning. Solvent cleaning removes all visible grease, oil, soil, drawing and cutting compounds and other soluble contaminants. Hand Tool Cleaning removes loose rust, loose mill scale, and loose paint, and incorporates the use of wire brushes, scrapers, abrasive pads, chipping hammers, chisels, etc. Power tool cleaning to bare metal removes all rust, paint, mill scale and other contaminants, as well as developing a surface profile. Abrasive blast cleaning can also be used.

All steel cleaned to the required cleanliness is to be prime coated the same day. Allowing steel to sit overnight, especially in the field, will result in contaminants being deposited on the surface. The surface must meet the cleanliness standard just prior to application of the primer; if not, it must be re-cleaned.

A surface profile is also specified independent of surface cleanliness. Central lab personnel test and measure the surface profile using replica tape and a spring micrometer, for compliance to specification requirements.

Assessing surface cleanliness is a subjective evaluation performed with the unaided eye. The written definitions take precedence in determining if work is performed in accordance with the specifications. Visual standards are available to assist on the evaluation, but factors such as the abrasive used, condition of the steel, surface profile, and color of paint stains affect appearance. The Preferred method is on the job, where a section it cleaned, and after agreement, becomes the standard for the job.

SPECIFICATIONS/DETAILS

Cleaning and Painting for Structural Steel
http://www.dot.state.ut.us/download.php/200309221511592/09972-PaintingforStructuralSteel.doc
Cleaning and Repainting for Structural Steel
http://www.dot.state.ut.us/download.php/200309221512342/09991-Cleaning_RepaintingStructuralSteel.doc
Cleaning and Overcoating for Structural Steel
http://www.dot.state.ut.us/download.php/200309221513072/09992-Cleaning_OvercoatingStructuralSteel.doc

COST INFORMATION

Currently the unit cost to remove and repaint is approximately $7.00/ft^2 (2003 dollars). When working on a complicated bridge and dealing with lead based paint, it can be as high as $9-10/ft^2. A preventive top-coat is around $3.50/ft^2. UDOT's Bridge Preservation Management Strategy is to do a "preventive top coat" at years 20, and 40 with a repaint at 60 years. Based on the square footage of steel bridges and frequency, UDOT could be painting up to $3-4 Million per year. UDOT has a $12 Million Bridge Preservation program, and typically about $1 Million, or 8.33% of this, is directly spent on painting

FURTHER INFORMATION

Contacts **UDOT: Bill Lawrence @ (801) 965-4560, BillLawrence@utah.gov**
SSPC: Susan Prokopchak @ (412) 281-2331 Ext 210, Prokopchak@SSPC.org